UNITED NATIONS

E

Economic and Social Council

Distr.
GENERAL

EB.AIR/GE.1/2004/7
EB.AIR/WG.5/2004/5

28 June 2004

ORIGINAL: ENGLISH

ECONOMIC COMMISSION FOR EUROPE

EXECUTIVE BODY FOR THE CONVENTION ON
LONG-RANGE TRANSBOUNDARY AIR POLLUTION

Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission for Air Pollutants in Europe (EMEP)
(Twenty-eighth session, Geneva, 6-8 September 2004)
Item 4 (f) of the provisional agenda
Working Group on Strategies and Review
(Thirty-sixth session, Geneva, 13-16 September 2004)
Item 4 of the provisional agenda

INTEGRATED ASSESSMENT MODELLING

Progress report prepared by the Chairman of
the Task Force on Integrated Assessment Modelling in collaboration with the secretariat

Introduction

1. This report presents progress in integrated assessment modelling and in the preparation of model inputs, with a focus on the preparation of the baseline scenarios to be assessed in readiness for the review of the Gothenburg Protocol. It includes the results of the twenty-ninth meeting of the Task Force on Integrated Assessment Modelling, held in Amiens (France) on 10-12 May 2004. The presentations made during the meeting and the reports presented can be accessed on the Internet at www.unece.org/env/tfiam.

2. Experts from Belgium, the Czech Republic, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Slovenia, Sweden, Switzerland, the United Kingdom and the European

Community participated in the meeting. Representatives from the EMEP Centre for Integrated Assessment Modelling (CIAM) at the International Institute for Applied Systems Analysis (IIASA), the Meteorological Synthesizing Centre-West of EMEP (MSC-W), the Coordination Center for Effects (CCE), the World Health Organization (WHO), the European Topic Centre on Air and Climate Change (ETC/ACC), as well as from the Oil Companies' European Organization for Environment, Health and Safety (CONCAWE), and the Union of the Electricity Industry (EURELECTRIC), were present. A member of the UNECE secretariat also attended.

3. Mr. Rob Maas (Netherlands) chaired the meeting.

I. REVIEW OF EMISSIONS AND SOURCE RECEPTOR DATA

4. Ms. Leonor Tarrasón (MSC-W) presented a summary of the findings and conclusions of the workshop on the review of the unified Eulerian model, held in November 2003 in Oslo, emphasizing the consideration of the source-receptor relationships for sulphur, nitrogen, ozone and particulate matter (PM) and the recommendations for future work, as well as ongoing work on these issues. Changes in meteorological conditions introduced variability in the scenario analysis that was comparable to the expected changes in particulate matter concentrations due to emission reductions in 2010. In 2020, expected changes due to emission reductions would become more significant than the meteorological variations. Source-receptor relationships for integrated assessment modelling needed to be calculated for as many different meteorological years as possible. The full report of the workshop can be found at www.nilu.no/projects/ccc/tfmm.

II. ABATEMENT OPTIONS AND EMERGING TECHNOLOGIES

5. Mr. Michael Ball (French-German Institute for Environmental Research (IFARE)) and Mr. Franck Delacroix (Agence de l'Environnement et de la Maîtrise de l'Energie (ADEME)) presented progress in the work of the Expert Group on Techno-economic Issues and the development of the ECODAT database. They highlighted improvements in the user layout of the database and its extension to include emerging technologies. The volatile organic compounds (VOC) and off-road modules were examined by CIAM for adapting the RAINS model, and the aggregation routine was implemented in ECODAT. The cooperation of industry was generally good, but it depended on the sector. Greater participation of Parties would be needed in the future. The question was also raised whether the work of the Expert Group would be a temporary project or a long-term task.

6. The Task Force recognized the importance of the Expert Group's process in improving the RAINS model data and the countries' own databases. It could produce more detailed data than the RAINS model, but the benefit of this disaggregation was still to be identified. The Task Force agreed that a harmonized approach on emission reduction possibilities was important and the

ECODAT database should be updated regularly once it had proven its success. The need for harmonization between the Expert Group and RAINS, including a harmonized procedure for the delivery of data, was recognized. Nevertheless, priority should be given to providing data for the RAINS model, followed by efforts to deliver more detailed data for the Expert Group.

7. With regard to the use of the Expert Group's data by the RAINS model, Mr. Markus Amann (CIAM) stressed that the Expert Group's process could make an important contribution to the modelling work, provided the data were delivered by a greater number of Parties. Some practical problems in terms of timeliness, validation and completeness limited the extent to which CIAM could use the data. CIAM could only take into account data that were available within a certain time frame to avoid delays in its work on the baseline scenario analysis. In some cases experts disagreed with the Expert Group's data; therefore, the data should be discussed and agreed with the various stakeholders. He indicated that small combustion sources were one area where the Expert Group could contribute significantly.

8. Data produced by the Expert Group by the middle of 2004 could also be used for the review of the European Union's (EU) National Emissions Ceilings (NEC) Directive. The possibilities for linking the Expert Group's process with emission reporting to EMEP should also be explored.

9. Further information on the work of the Expert Group is presented in its report to the Working Group on Strategies and Review (EB.AIR/WG.5/2004/8) and on the Internet at http://citepa.org/forums/egtei/egtei_index.htm.

10. Mr. André Zuber (European Community (EC)) reported on projects set up by the European Commission to provide more information in certain key sectors. Small-scale combustion installations had been identified as an important source of air pollution, particularly with regard to exposure of the population to PM. The European Commission had contracted AEA Technology for this task with the aim of establishing an updated emission inventory and estimates of the costs of reducing emissions from these sources. New emerging technologies would also be assessed. This would include an analysis of emissions from selected sectors and the identification and description of promising emerging technologies. The project focused on process-integrated or end-of-pipe technologies that were beyond best available technology (BAT) and were relevant to the reduction of air pollution and greenhouse gas emissions by 2030.

III. BASELINE SCENARIOS

11. Mr. Amann presented the first results of the baseline scenarios for the European Commission's Clean Air for Europe (CAFE) programme. For the analysis, the most recent version of the RAINS model was used. In a series of 23 bilateral discussions involving 94 experts

from Parties and industrial associations, CIAM had discussed all country-specific databases of the RAINS model. To date, two baseline projections that explored two alternative assumptions on climate policies and the resulting implications on energy development had been analysed. These energy projections had been developed by the PRIMES energy model for all 25 EU member States, based on Europe-wide harmonized assumptions. Assuming implementation of the present source-specific EU legislation on emission controls (e.g. Large Combustion Plant Directive, regulations for mobile sources, Solvents Directive, etc.) but not considering further measures that might be necessary to comply with the NEC Directive, emissions of SO_2, NO_x, VOC and PM were expected to significantly decline in the years up to 2020. Especially large reductions were projected for the new EU member States, following the anticipated continued structural changes in energy consumption and the full implementation of EU emission legislation. For ammonia emissions, however, no significant decline could be expected from the present "business as usual" scenario. The impacts of a reform of the EU common agricultural policy were not included.

12. Following the reductions in emissions, air quality was also expected to improve significantly. Preliminary analysis of the RAINS model suggested that PM and ozone levels in Europe would improve, leading to less harmful impacts on human health and ecosystems. For PM, the average losses in statistical life expectancy that could be attributed to the modelled contribution to PM2.5 from anthropogenic sources excluding secondary organic aerosols were calculated to shrink from 280 days in the year 2000 to 170 days in 2020. The cases of premature deaths that could be attributed to ozone exposure originating from European anthropogenic emissions would decline from 10,000 in 2000 to 7,000 in 2020. While the protection of forest ecosystems was also expected to improve, a better scientific understanding of deposition processes and finer resolved atmospheric modelling rendered less optimistic projections than those available for the analysis of the Gothenburg Protocol. CIAM planned to finalize the CAFE baseline projections by summer 2004, including the modelling of national energy projections.

13. The Task Force took note of the results with appreciation. Parties were invited to react to the results before the end of May. They were also invited to submit national projections. Non-EU countries were also invited to submit national projections and take part in the bilateral consultations with CIAM.

14. Mr. Hans Eerens (ETC/ACC) presented the results on air and climate change scenarios for the forthcoming State-of-the-Environment and Outlook Report 2005 of the European Environment Agency (EEA). They included a "sustainable emissions pathway" scenario, focusing on a long-term climate change target of 2°C compared to pre-industrial levels. The assessment suggested that there were sufficient options to meet European air pollutant and greenhouse gas emissions targets (NEC/Gothenburg Protocol and Kyoto Protocol) up to 2030. Additional technological solutions, including renewables, fuel cells combined with carbon capture and storage, and nuclear energy, were also analysed. These options would entail significant CO_2

emissions reductions: 15-25% by 2020 and 35-50% by 2030.

IV. DEVELOPMENT OF THE RAINS MODEL

15. Mr. Matti Vainio (EC) gave an update of the development of the TREMOVE model, which had started in 2002. Currently, the TREMOVE baseline was being compared for consistency with the RAINS baseline up to 2020. Some differences were expected, due to the use of more detailed activity data in the TREMOVE model. The TREMOVE model would make it possible to analyse in detail issues related to the transport sector. It was important for TREMOVE and RAINS models to use common assumptions and to be comparable. The teams developing the models were working in close cooperation. The TREMOVE model would be ready for policy applications in early autumn 2004. A peer review of the TREMOVE model was under way in the Czech Republic, Hungary, Poland and Slovenia. More information is available at: www.tremove.org.

16. Mr. Vainio gave an update of the development of the methodology for cost-benefit analysis for the CAFE programme. He pointed out that the methodology was developed in a transparent manner and in consultation with stakeholders. The draft methodology paper would undergo a peer review in the summer of 2004. The final aim was to have a methodology that was applicable not only in the CAFE context but also to the review of the Gothenburg Protocol. Mr. Vainio highlighted the importance of developing multi-criteria analysis to complement (and not duplicate) cost-benefit analysis. Otherwise, important environmental effects (e.g. biodiversity) might be excluded, if they could not be quantified or monetized. More information is available at: www.europa.eu.int/comm/environment/cafe/cba

17. The Task Force noted with appreciation the invitation of the European Commission to non-EU countries to provide data and join this exercise. It also stressed the need for close operation with ecosystem experts to ensure the appropriate use of critical loads in benefit studies.

18. Mr. Peringe Grennfelt (Sweden) presented the objective and the outline of the RAINS review process, initiated by CAFE and the Task Force. The objective was to review how the RAINS model used the scientific and economic understanding for the development of air pollution policies. The review group of ten independent experts was requested to assess to what extent RAINS was a scientifically credible representation of reality and to what extent limitations might restrict the validity of policy advice. Uncertainty treatment was an important element of the review process. The review group not only focused on the treatment of statistical uncertainties, but also on uncertainties due to a lack of knowledge, simplifications and model limitations, and on future developments. Mr. Grennfelt proposed a way of assessing uncertainties in the model more systematically. The review would be directed towards the RAINS model itself and the use of input data on technologies and costs, atmospheric dispersions and impacts. The documentation prepared

for the review is available at: http://www.iiasa.ac.at/rains/review/index.html. The final report of the review was expected during the summer.

19. Participants commented on the review process in a tour de table. In general, the judgement of the RAINS model was positive. The material on the web site was considered very useful and it gave a lot of insight into the RAINS model. The review provided a good opportunity for all the Parties to know better what the model included. Some participants noted that the increasing complexity created a growing communication problem. The need for improvement of the data delivery process, and the feedback to Parties that commented on the RAINS data, were mentioned. Participants stressed the need for improving and extending the model, e.g. with climate change measures, non-technical measures, shipping emissions and abatement options, scenarios for agricultural and world trade policies, the assessment of impacts on the competitiveness of countries and the impacts on biodiversity. Remarks were made on the influence of modelling assumptions on policy advice: the definition of target variables, the modelling scale, the normative choices in the ecosystems to be protected, and the country-to-grid approach. Some participants advocated modelling abatement strategies at the subnational level. Some stressed that the compensation mechanism that was used in the model would give the possibility for large countries to average their emission reduction efforts in densely industrialized areas with low density industrialized areas and hence attain lower marginal costs than smaller countries that did not have this possibility. Further analysis would be needed to show that the optimization results were robust.

20. Some reservations were expressed about the transparency and the use of the optimization tool. This tool focused on the total cost-effectiveness for Europe, without sufficiently taking into account equity principles in the costs per country.

21. Mr. Amann presented recent improvements to the RAINS model. CIAM, together with MSC-W, had explored the linearity of responses of air quality and deposition indicators to changes in precursor emissions, as computed by the new EMEP Eulerian model. For acid deposition, the response was largely proportional to changes in emissions, though co-deposition of ammonia and sulphur introduced a small deviation from linearity. For ozone, the responses of the new EMEP model were in line with those of the earlier Lagrangian model, indicating that ozone responded along a quadratic function to changes in NO_x emissions. For particles, certain non-linearities had been detected. Following the advice of the joint Task Force on Health, estimates of premature mortality that was attributable to ozone from anthropogenic emissions in Europe were included in the RAINS model. It associated premature mortality with daily maximum ozone eight-hour mean concentrations exceeding 35 parts per billion (ppb), which was representative for current background concentrations. For vegetation, the RAINS model implemented the concentration-based approach for ozone critical levels for forest trees as recommended by the Mapping Manual of the International Cooperative Programme (ICP) on Modelling and Mapping.

The flux-based approach was planned to be used for ex-post analysis of emission control scenarios. Due to the incomplete spatial coverage of the available estimates on dynamic acidification for the entire EMEP region, it was foreseen to evaluate the dynamic acidification processes for given emission control strategies, but not to use this information to drive directly the calculations of the RAINS model. To explore the uncertainties of atmospheric dispersion calculations in RAINS, CIAM together with MSC-W and the EU Joint Research Centre (JRC) had initiated a EURO-DELTA model intercomparison exercise for long-range dispersion models.

22. The Task Force agreed with the proposed changes in the model and to show the results of the dynamic model only as an ex-post exercise.

V. ASSESSMENT OF EFFECTS

23. Mr. Jean-Marc Brignon (France) informed the Task Force about work at the National Institute for Industrial Environment and Risks (INERIS) on the inclusion of urban PM exposure in integrated assessment modelling. Important benefits were expected from PM exposure reduction in urban areas. An integrated approach would help define the division of effort between international and local policies in Europe. A statistical model was used to identify the share of local combustion sources in PM10 concentrations in the "City-Delta" cities. The first results indicated that the relative share of local PM emission was generally below 50% and highly variable. Therefore, it could be useful to assess more cities than currently under study in the City-Delta project.

24. Mr. Frank de Leeuw (ETC/ACC) informed the Task Force about progress in the CAFE street emission ceiling project, which aimed to develop a method for determining what local emission reductions in streets were needed to reach certain air quality limits. The project would provide an assessment tool for local authorities in estimating air pollution in streets and identifying potential problems. It would also be used within the CAFE process to provide similar information for hot spots. Preliminary results of the ongoing analysis of observed air quality data for PM10, PM2.5 and NO_2, NOx at hot spots in 6-10 cities indicated that the observed concentrations and traffic emission estimates were consistent. The first model applications were fairly successful in reproducing the measurement data. Model applications should be expanded to more cities and more model systems. An intercomparison of street models had been initiated.

25. Mr. Jurgen Schneider (WHO) presented the results of the seventh meeting of the Task Force on Health, held on 6-7 May 2004 in Bonn (Germany), and progress on the WHO project “Systematic review of health aspects of air pollution in Europe”. He highlighted the recommendations of the Task Force on Health on how to treat the ozone and PM health impacts in the RAINS model. The effects of ozone on health were independent of those of PM. Current evidence was insufficient to derive a level below which ozone had no effect on mortality. The use

of a cut-off for integrated assessment modelling at 35 ppb was recommended, which corresponded roughly with the background ozone concentration. This would ensure a conservative approach of modelling (changes in) health effects, taking also account of uncertainties in relation to the evidence in health studies. It was also recommended to make a sensitivity analysis applying no cut-off, to outline the upper estimate of the attributable effects of ozone on mortality. There were still important effects with morbidity outcomes which were currently not covered, but should eventually be taken into account in any cost-benefit analysis.

26. The health effects of PM on mortality probably outweighed those of ozone. It was recommended to use the annual mean of anthropogenic PM2.5 as indicator for PM-related mortality. Most epidemiological studies on large populations had been unable to identify a threshold concentration below which ambient PM had no effect on mortality and morbidity. It was likely that within any large human population, there was a wide range in susceptibility so that some subjects were at risk even at the low end of current concentrations. It was currently not possible to quantify the contributions from different sources and different PM components to health effects from exposure to ambient PM. Further information can be found at: http://www.euro.who.int/air.

27. Mr. Max Posch (CCE) reported on the dynamic modelling of ecosystem effects. Critical loads did not give information on the time aspects involved in ecosystem dynamics. Dynamic models simulated the necessary time for chemical (and biological) recovery after non-exceedance of critical loads was achieved (recovery delay time). Target load functions could be used in RAINS in the same way as critical load functions. The recent call for data, in addition to updated critical loads for 25 countries in Europe, provided for the first time European-scale results of dynamic modelling for acidification. About 10 countries, covering much of the still-exceeded area in Europe, had delivered target load functions for the years 2030 and 2050. The data would be available after approval by the Task Force on Modelling and Mapping and the Working Group on Effects.

28. The Task Force on Integrated Assessment Modelling, at its twenty-eighth meeting, noted that the original data on critical loads and levels should be re-evaluated prior to their use in cost-benefit analysis (EB.AIR/GE.1/2003/4, para. 27). Mr. Jean-Paul Hettelingh (CCE) reported on the development of robust country-dependent impact factors for acidification, which could be used for cost-benefit analysis after updating the figures with the new EMEP Eulerian model. He also reported on the results of the land cover workshop held on 10 March 2004 at IIASA, Laxenburg (Austria). A harmonized land-cover map, combining CORINE and the Stockholm Environment Institute (SEI) information, was now available at CCE to be used for ozone and deposition impact assessment.

29. The Task Force suggested that CCE should present an indication of the additional deposition (and emission) reduction requirements that would be needed for various recovery targets in comparison to the critical load approach at the next meeting of the Working Group on Strategies and Review.

VI. OTHER INTEGRATED ASSESSMENT MODELLING ACTIVITIES

30. Mr. Amann presented the first findings from an extension of the RAINS model to include the control of greenhouse gases. With funding provided by the Netherlands Ministry for Public Housing and the Environment, CIAM was developing cost curves for the six greenhouse gases included in the Kyoto Protocol, fully consistent with cost curves for the conventional air pollutants, and implementing them for all European countries. The first results indicated important economic synergies between the mitigation of greenhouse gas emissions and the control of air pollutants. In particular, the costs of fuel shifts targeted at a reduction of CO_2 emissions could be compensated to a significant extent by avoided costs for air pollution control. In addition to CO_2 reductions, fuel shift strategies could also yield important improvements in health effects through associated reductions in PM exposure, even under the tight emission control regimes at present in force in Europe. Multi-gas strategies that incorporated non-CO_2 greenhouse gases, e.g. methane, could further decrease the net costs of greenhouse gas reductions. However, some measures that reduced greenhouse gas emissions, such as an increased use of biofuels in households, could increase health impacts of air pollution. The extended RAINS model, to be finalized by the end of 2004, would provide a tool for a systematic analysis of the synergies and trade-offs between air pollution control and greenhouse gas mitigation.

31. Mr. Frank Raes (JRC) reported on a study of JRC together with IIASA on the relationship between climate change and air quality policies. In particular, the effects of CH_4 emission reductions on ozone, and of NOx, CO and VOC emission reductions on CH_4, were calculated with a global atmospheric chemistry and transport model. Preliminary results of the study showed that a NOx and VOC reduction policy would prolong the CH_4 lifetime. A maximum feasible CH_4 reduction policy alone would already reduce the northern hemispheric background ozone levels by 2-3 ppb. A maximum feasible reduction for CH_4, NOx, CO and VOC would reduce northern hemispheric ozone by 6-9 ppb.

32. Mr. de Leeuw presented the IMAGE model, an integrated assessment model addressing climate change. In the current model version, focusing on CO_2, the climatology and atmospheric chemistry were modelled in a strongly simplified but adequate way. An update of the atmospheric part of the model was proposed. The climatology would be simulated using the global circulation model Speedy, which would be dynamically linked with a global atmospheric chemical model. This combination would make it possible to study various interactions between climate change and air quality. The model may provide boundary conditions of ozone for continental scale

models to study the impact of global change emission scenarios on ground-level concentrations.

33. Mr. Stefan Reis (University of Stuttgart (Germany)) presented the current state of work in the MERLIN project. The model had been implemented and was currently running test cases based on EMEP source-receptor matrices for all relevant pollutants (2003 meteorology). With the availability of additional source-receptor matrices, average values would be used for the final scenario calculations for cost-effectiveness and cost-benefit assessment of combined air pollution control and greenhouse gas emission reduction strategies. The MERLIN data set of abatement measures included technical and non-technical emission control options, integrating their implementation in a single framework to investigate their joint reduction potentials and costs in order to conduct cost-effectiveness and cost-benefit analysis of strategies that went far beyond the business-as-usual trend development for 2010. More information can be found at: http://www.merlin-project.info. The final results of the project would be presented at the International and National Abatement Strategies for Air Pollution (ASTA) workshop in Gothenburg (Sweden) in October 2004.

34. The Task Force recommended the further harmonization of input data in order to increase comparability with the results of the RAINS model.

35. Ms. Helen ApSimon (United Kingdom) presented progress in integrated assessment modelling at Imperial College. Work had concentrated on integrating modelling at different scales, and linking local scale issues of air quality (using the urban scale integrated assessment model, (USIAM)) and national scale considerations (with the United Kingdom integrated assessment model (UKIAM)) with transboundary assessments covered by the RAINS and ASAM models. Urban scale assessments placed emphasis on traffic emissions in achieving air quality limit values, whereas protection of ecosystems at the national scale depended critically on where emissions were reduced spatially within the country. A detailed comparison was in progress between the new EMEP Eulerian model and United Kingdom models used for policy purposes. This indicated improvement in modelling secondary particulates but uncertainties in scientific understanding of HNO_3, particulate nitrate, and NH_3 concentrations with implications for nitrogen deposition. Greater (5x5 km) grid resolution in United Kingdom modelling gave larger estimates of exceedance than the EMEP 50 kmx50 km resolution.

36. Mr. Sebastien Soleille (France) informed the Task Force about a study initiated by INERIS on defining emission reduction strategies with the CHIMERE model, combining national emission ceiling approaches with sector-based strategies. If carefully designed, they might reduce the risk of induced competition distortion, might be easier to translate into practice and more predictable by industry. Therefore they might be more acceptable to stakeholders and more enforceable by governments.

37. Mr. Tiziano Pignatelli (Italy) provided information about the MINNI project that aimed to develop, verify and validate a modelling system dealing with air pollution dynamics (transport and dispersion) and multiphase chemical transformations, to evaluate concentrations and deposition fluxes of the pollutants included in national and international air quality policies. The results from the atmospheric simulation system would be included in RAINS-Italy, a national-scale version of the RAINS model. Matrices of source-receptor relationships for the Italian regions would also be calculated, including shipping emissions from coastal seas.

38. The Task Force welcomed the presentations on integrated assessment modelling initiatives and encouraged the experts to continue to inform it about further progress in their work. It encouraged all national focal points to come forward with their results at its future meetings.

VII. PLANNING FURTHER WORK

39. The Task Force discussed its work-plan for 2005 based on the work-plan adopted by the Executive Body for 2004 (ECE/EB.AIR/79/Add.2, annex XII, item 2.3).

40. The Task Force agreed that the activities that needed to be carried out included work on:

(a) The baseline scenarios, input to the workshop on the review of the Gothenburg Protocol in October 2004 and input to the European research agenda for the next five years;

(b) A workshop on the progress of the RAINS model in January 2005 at IIASA in Laxenburg (Austria);

(c) Further assessment of uncertainties;

(d) Examination of effects of hemispheric background pollution on source-receptor relationships in Europe;

(e) Methods for including results of dynamic modelling in integrated assessment modelling;

(f) Systematic differences in response to emission changes between regional and urban-scale models and abatement measures to address urban pollution;

(g) Evaluation of the cost-effectiveness of measures to reduce regional air pollutants taking into account their impacts on climate change;

(h) Scenarios of maximum feasible emission reductions taking into account the

potential of non-technical measures and new emerging technologies.

41. The Chairman of the Task Force, in cooperation with CIAM, would explore possibilities for the development of emission projections for certain persistent organic pollutants (POPs) and heavy metals that could be used in assessing trends in deposition.

42. The next meeting of the Task Force on Integrated Assessment Modelling was tentatively scheduled for May 2005. The venue had not yet been chosen.